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(54) Ink tank cartridge and container therefor.

(57) An ink tank cartridge (5) is disclosed including a housing (11,50) removably mounted onto an ink supply needle (14,90) of the ink-jet type recording apparatus body. The housing being provided with an ink supply port (15,53,71) projecting from a bottom surface of the housing both inwardly and outwardly. A porous member (21,64) for impregnating ink is positioned inside the housing abutting against the ink supply port through a filter (17,55). The ink tank cartridge being further provided with a packing member (19,57,73) resiliently abutting against an outer periphery of the ink supply ne dle at the nd of the ink supply port. An end opening is sealed with a sealing member (20,60,77) through which the ink supply needle penetrates.

Accordingly, the ink tank cartridge of the invention is advantageous in that the ink supply needle does not require a sharp tip, air is prevented from entering the ink supply path of the recording apparatus, and a tight air-seal between the ink supply needle and the ink tank can be maintained.

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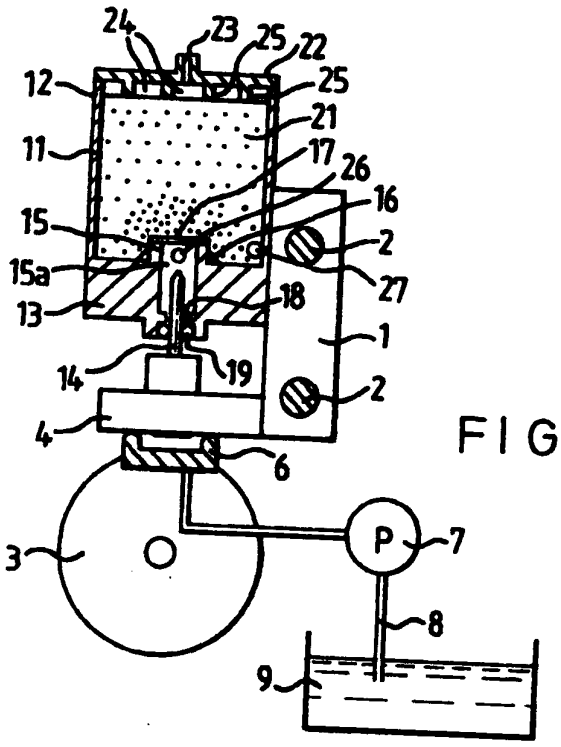

FIG.2

The present invention relates generally to an ink tank cartridge for use in an ink tank cartridge for use in an ink-jet type recording apparatus for ejecting ink droplets onto a recording medium and more particularly to a structure of an ink tank cartridge for use in the ink-jet type recording apparatus.

Generally, according to the recording apparatus of this type, an ink is supplied to a recording head from an ink tank constructed as a cartridge. Employment of the ink cartridge acting as an ink tank has advantages in that no smear is likely to occur due to the leakage of ink while refilling new ink or the like. However, undesired air bubbles can easily enter the tank which may cause problems, such as ink-failure.

In order to prevent air bubbles from entering the ink tank, several techniques have been proposed. For example, Unexamined Japanese Patent Application (OPI) No. Hei. 3-92356 discloses an ink-jet recording apparatus in which an ink supply port disposed below an ink tank is constituted by a rubber tap. A metal ink supply needle penetrates through the rubber tap into an ink flow path communicating with ink nozzles of a recording head. The ink supply needle has ink supply holes on a side surface thereof to penetrate easily through the rubber tap, the diameter of which is about 1mm and is constituted by a metal pipe formed of an anti-corrosion material, such as stainless steel and the end of the pipe is extremely sharp. Accordingly, a person must operate the sharp needle very carefully or (s)he may be injured by the tip of the needle.

To overcome the above problem and difficulty, Unexamined Japanese Patent Application (OPI) No. Sho. 50-074341 proposes an arrangement in which a packing member having a through hole is previously provided at an end opening of an ink supply port and the through hole of the packing member is sealed by a seal member. According to this arrangement, an ink supply needle having a tip which is not so sharp can be employed.

However, in any event, those conventional ink-jet recording apparatuses use an ink tank in which a liquid ink is contained directly therein. Accordingly, the apparatuses suffer from several problems such as leakage of ink or a waterhead difference; waterhead being a term explained hereafter.

It is advantageous to maintain an ink supply pressure (negative pressure) from an ink tank to a recording head within a range from -30 to -100 mmAq (i.e. a waterhead) so as to achieve a stable ink ejection of the recording head of the ink-jet type recording apparatus. However, it is difficult to control the ink supply pressure using a height differential at which the ink tank is installed, particularly in the case of an ink-jet recording apparatus of an on-carriage type in which a recording head and an ink tank cartridge are mounted on a carriage. Unexamined Japanese Patent Application (OPI) No. Hei. 2-187364 proposes that a porous member is housed within an ink tank (cartridge) thereby to generate a negative pressure between the ink tank and the recording head owing to capillary action of the porous member.

However, since the Japanese Patent Application Hei. 2-187364 is directed to one type of recording apparatus by which both an ink tank and a recording head are formed unitarily and both these components are replaced with a new one when ink contained in the ink tank becomes empty, it does not address the other problems or difficulties, such as undesired air flow to the recording head or leakage of ink which may occur when only the ink tank is selectively removed from the head.

The present invention is made in view of the foregoing problems or difficulties accompanying the conventional ink-jet type recording apparatus employing a cartridge type ink tank structure. Accordingly, an object of the present invention is to provide an ink tank cartridge preferably for use in an ink-jet type recording apparatus which does not require any sharp needle and capable of preventing air or gas from entering an ink supply path of the recording apparatus body even when the ink tank is replenished using the ink supply needle and keeping a high air tightness between the ink supply needle and the ink tank.

The above and other objects can be achieved by provision of an ink tank cartridge which includes, according to the present invention, a housing removably mounted onto an ink supply needle of the ink-jet type recording apparatus body. The housing is provided with an ink supply port projecting from a bottom surface of the housing both inwardly and outwardly and a porous member for impregnating ink which is positioned inside the housing with abutting against the ink supply port through a filter. The ink tank cartridge is further provided with a packing member resiliently abutting against an outer periphery of the ink supply needle at an end of the ink supply port and an end opening which is sealed with a sealing member through which the ink supply needle penetrates.

When the ink tank cartridge is mounted onto the ink supply needle, the tip of the ink supply needle penetrates through the sealing member and passes through the packing member disposed above the sealing member to thereby communicate with ink impregnated within the porous member accommodated in the cartridge housing. Accordingly, the ink supply needle communicates with ink contained inside the tank which is liquid-tightly sealed by the packing member at the outer periph ry of the needl , so that the ink is supplied to the r cording head whilst keeping a constant negative pressure between the recording head and the tank owing to surface tension of the porous member.

Fig. 1 is a schematic perspective view showing an example of an ink-jet type recording apparatus to which an ink tank cartridge according to the present invention is applied;

Fig. 2 is a cross-section along the line A-A of figure 1, of a first embodiment of the ink tank cartridge according to the present invention which is applied to the recording apparatus;

Fig. 3 is an enlarged cross-section of an ink supply needle and peripheral parts shown in Fig. 2;

Fig. 4 is a circuit diagram of an ink near-end detecting circuit;

Fig. 5 shows one example of the bag packing therein the ink tank cartridge according to the present invention;

Fig. 6 shows the variation of an amount of nitrogen against the time after opening the packaging bag;

Fig. 7 shows an arrangement of packing the ink tank cartridge according to the present invention;

Fig. 8 shows an arrangement of the ink tank cartridge having a flange with respect to a finger;

Figs. 9-I and 9-II are cross-sections showing ink tank cartridges according to a second embodiment of the present invention;

Figs. 10A-1 to 5 are enlarged cross-sections of sealing members and sealing members stopping member shown in Figs. 9-I or 9-II;

Fig. 10B is a cross-section cut along the line B-B of Figs. 10A-1 to 5;

Fig. 11 is a cross-section showing part of an ink tank cartridge according to a third embodiment of the present invention;

Fig. 12 shows an embodiment of the ink supply needle preferably applied to the ink tank cartridge of the present invention; and

Figs. 13A and 13B are cross-sections of the ink supply needle being applied to the ink supply cartridge.

Preferred embodiments of the present invention will now be described in detail with reference to accompanying drawings; of which

Fig. 1 is a schematic perspective view showing an example of an ink-jet type recording apparatus to which an ink tank cartridge according to the present invention is applied. As shown in Fig. 1, the ink-jet type recording apparatus is provided with a carriage 1 slidably mounted on guide shafts 2 with respect to a longitudinal axis of a platen 3. On the carriage there is installed an ink-jet recording head 4 for ejecting ink droplets in accordance with a print signal and an ink tank cartridge 5 for supplying ink to the recording head. A capping apparatus 6 is disposed outside a printing region which engages with a front surface of the recording head 4 to prevent nozzle openings from drying when printing has stopped. The nozzle openings are sealed by the capping apparatus 6 and forced to eject ink by a negative pressure generated by a vacuum pump 7 immediately after the ink tank cartridge 5 is replaced with a new one or an ink ejection ability is lowered during continuous printing. The ejected ink is introduced to an ink storage tank 9 through a pipe 8 and stored therein.

The apparatus further includes a transmission cable 10 for transmitting printing signals to the recording head 4.

Fig. 2 is a cross-section of a first embodiment of the ink tank cartridge according to the present invention which is applied to the recording apparatus. The ink tank cartridge is provided with a housing 11 constituting an ink tank cartridge body, which has an opening 12 at the top and an ink supply port 15 formed unitarily therewith at a bottom surface 13 with which a hollow ink supply needle 14 resiliently engages. The housing 11 is tapered in such a manner that the bottom surface 13 is smaller in diameter than the top surface. However, the housing need not be tapered but a cylindrical shape having a straight wall may be employed.

The ink supply port 15 is pipe-like shaped and projects from a bottom surface of the housing 11 both inwardly and outwardly. A mesh filter 17 having a pore size of 20 to 100 μm is fuse bonded onto an upper opening 16 of the ink supply port 15 projecting towards inside the housing 11. The filter may be formed of a high polymer material or an anti-corrosion metal such as stainless steel. A step portion 18 is formed at an inner central portion of the ink supply port 15. A packing member 19 for resiliently contacting the ink supply needle 14 to the inside of the supply port 15 is disposed inside the ink supply port 15 at a lower side of the step portion 18 for providing a liquid seal.

In this embodiment, the packing member 19 is formed of a rubber ring, a so called O-ring. A sealing film 20 is fuse bonded onto a lower opening of the ink supply port 15. The film 20 may preferably be formed of a sealing material such as a high polymer film or a high polymer film with metal layer laminated on the film so that the film 20 demonstrates a high sealability while not capable of being torn by an external force such as contact by a finger.

A porous member 21 has a width which is a little bit larger than that of the opening 12 of the housing 11 and a height which is a little bit higher than the housing, so that the porous member 21 is compressed within the housing 11. Further, the lower end portion of the porous member 21 facing the filter 17 of the ink

supply port 15 is compressed by the ink supply port 15 protruding inside the housing. A lid 22 covers the opening 12 of the housing 11 and includes a plurality of ribs 25 projecting towards the inside of the housing 11 to compress the porous member 21 and keep respective spaces 24 within th ink tank cartridge betwe n the lid 22 and the porous member 21.

An electrode 26 is provided in the ink supply port 15 while another electrode 27 is provided in the bottom portion of the housing 11 to detect an ink near-end condition where the ink is almost empty in the tank and there is only ink in the ink supply port 15. As shown in Fig. 4, an AC voltage Vcc is applied to the electrodes 26, 27 through a resistor R, and the variation in voltage between the electrodes is detected by a differential circuit 30. A comparator 31 compares an output signal of the differential circuit 30 representing a voltage variation ratio with a preset value generated by a preset value supplying circuit 32. If the voltage variation ratio is larger than the preset value, that is, the ink impregnated in the porous member 21 becomes almost empty, an ink near-end signal is output and the ink near-end condition is therefore detected.

As shown in Fig. 3, the hollow ink supply needle 14 cooperating with the ink tank cartridge has a conical end, and a plurality of through holes 36 are formed in a tip end surface 34 of the ink supply needle 14 for communicating the ink contained within the ink supply port 15 with an ink supply path 35 formed inside the needle 14.

The ink is filled in the pores of the porous member 21 accommodated within the housing 11 of the ink tank cartridge under low pressure of about 0.2-0.4 atmospheric pressure. The filling of ink under low pressure is very useful as a means for keeping a good printing quality as taught in Unexamined Japanese Patent Application (OPI) No. Sho. 60-245560.

After filling ink into the porous member 21, the ink tank cartridge is packed up for shipping in a bag formed of a high sealable material such as, for example, a laminate film having aluminum layers.

Fig. 5 shows one example of the bag, packing therein the ink tank cartridge according to the present invention. The ink tank cartridge is wrapped by a pair of laminate films 37 formed of aluminum which provide a very high sealability, decompressing air in the bag and then fuse-bonding at flange portions 38 of the films 37.

Japanese Patent No. Hei. 3-61592 teaches using 20 Torr as an example of the negative pressure to be applied during the packing of the ink tank cartridge, which pressure is much higher than the pressure under which the ink is filled within the tank. However, this may cause a problem since the ink tank cartridge is subject to atmospheric pressure because the location for the ink-filling process and that for the packaging process are usually spaced far from each other. Thus air which penetrates into the ink becomes free to produce air bubbles when the larger negative pressure is applied during the packaging process. As a result, undesirable ink-leakage may occur and, further, the air bubbles generated in the porous member may obstruct the ink current flowing from the ink tank cartridge to the recording head which would cause an ink-failure during printing.

Under these circumstances, the present inventors found that it is most preferable that the ink tank cartridge is packed under a negative pressure which is only a little bit larger (closer to atmospheric pressure) than the pressure under which the ink is filled within the tank.

When using ink comprising dyes which would generate free gas (due to the resolution), if low pressure is maintained within the packaged bag the amount of gas to be impregnated in the ink is lowered. Accordingly, deterioration of the print quality due to this free gas can be effectively prevented. Further, even when using an ink which is not subject to deaeration, the presence of the low pressure space within the bag helps the ink to deaerate while stocked and, moreover, the ink is prevented from leaking from the bag to the outside.

Next, the value of the low pressure during the packaging process and the deaeration rate of ink under the low pressure condition after a stocking period will be described with reference to an amount of nitrogen as a main part of air as a parameter.

Following experimentation, the deaeration rate of the ink contained within the ink tank cartridge can be controlled by varying the pressure during the packaging process. Table 1 shows the packaging pressure (negative gauge pressure) when the nitrogen density during the packaging process is set to be the saturation value of 13-14 ppm and the nitrogen density impregnating into the ink contained in the ink tank cartridge when the packaging bag is opened.

TABLE 1

Low pressure value (atmospheric pressure)	Amount of Nitrogen (ppm)
0.5	7.5-9.0
0.35	7.0-8.5
0.2	6.0-7.5

The description will now describe the variation of the deaeration of ink contained in the ink tank cartridge after opening the bag with reference to an amount of nitrogen contained in the ink as a parameter. Fig. 6 shows a variation of an amount of nitrogen after opening the packaging bag. Since the ink tank cartridge has a space kept by the ribs projecting from the lid, a constant amount of air corresponding to the pressure exists within the bag from immediately after the packaging process. Accordingly, within a short period (point a), the density of nitrogen within the ink rapidly rises as shown in Fig. 6, and after that, the density is constant because of the high sealability of the bag. The constant period continues for about two years from manufacture. After opening the bag (point b), the amount of nitrogen contained in the ink increases and reaches a saturation point (point c) about one week after opening. Even when saturated, the printing quality does not deteriorate within about one to four weeks (b to d)after opening within which one cartridge is normally used for printing.

It is more preferable that the space maintained in the packaged bag is substantially 15% of the total inside volume of the bag after packing.

The effect of deaeration of ink will now be described. When the ink tank cartridge is removed from and attached to the ink supply needle, an amount of air entering from the hollow needle is normally extremely small. According to experimentation, when the diameter of the hollow needle is about 0.8 mm, the amount of air entering was below 0.4 mm^3 at most which corresponds approximately to a meniscus of ink. The ink once entering the ink supply port flows towards the recording head and is trapped by a filter (not shown) mounted in a filter chamber. The air trapped by the filter would not easily pass through the filter because the pore size of the filter is very fine. According to experimentation, employing a filter having a diameter of 4 mm and a thickness (height of filter chamber) of 0.3 to 0.5 mm, after removing and attaching the ink tank cartridge to the needle as much as ten times or more, the air did not pass through the filter while the recording apparatus is operated.

Accordingly, during the period from the point b to c of Fig. 6, the deaerated ink is apparently supplied to the recording head, and even if the ink tank cartridge is removed and attached to the ink supply needle and air enters in the ink supply port from the needle, the air is impregnated into the ink and, accordingly, the recording apparatus does not suffer from any problem.

On the other hand, when the ink tank cartridge is removed from the apparatus and left for a while, air enters from the ink supply needle. As is known, air destroys the siphon phenomenon and causes an undesired ink-failure. To prevent such a problem, the ink-jet type recording apparatus is provided with a vacuum pump for forcedly ejecting ink from ink nozzles by applying a negative pressure to a recording head. In this operation, we have found that recovering from ink-failure depends on a deaeration rate of ink following experimentation. When using ink one to four weeks after the bag is opened, no problem occurs when the air contained in the filter chamber is ejected by the operation of the vacuum pump. On the other hand, however, after that time period if the amount of air contained in the ink is completely saturated or may even be excessively saturated due to a variation in temperature, fine air bubbles may be generated by an action of negative pressure during the ink-failure preventing operation, which causes the problem in obstructing ink flow.

Fig. 7 shows an arrangement of packing the ink tank cartridge in which a cartridge is surrounded by an absorbing member, such as sponge grains 40, and accommodated in a packaging bag 41, and then subjected to a decompression process. According to this arrangement, since the sponge grains 40 form a space inside the packaging bag, the low pressure during the packing process can be continued for a long time even if the ink is filled in the porous member 21 as much as possible, for example, about 95% volume of the porous member accommodated in the ink tank cartridge. Therefore, the print quality and efficiency of the ink-filling can be improved.

When the ink tank cartridge packed as described above is actually to be used, the packaging bag is opened and the tank cartridge is taken from the bag. The tank cartridge is mounted on a carriage of the recording apparatus in such a manner that the end opening of the ink supply port 15 is positioned just

above the ink supply needle 14 and then depressed towards and parallel to the direction of the needle 14. The ink supply needle 14 penetrates the sealing member (film) 20 and reaches the packing member (O-ring) 19. In this condition, the tip of the ink supply needle 14 is kept in a liquid seal with respect to the ink supply port 15 by the packing member (O-ring) 19 while communicating with ink contained within the ink supply port 15.

When the ink supply needle 14 penetrates the sealing member 20, the sealing member 20 deforms to become shaped like the end contour of the needle 14; to large extent because of the resiliency of the sealing member 20.

Since the through holes 36 formed at the tip of the ink supply needle 14 have a diameter below 0.1 to 0.4 mm, the through holes 36 keep a meniscus when the cartridge is exchanged. Accordingly, air is prevented from entering from the ink supply needle 14 to the recording head. Further, since there is a plurality of through holes, the fluid resistance applied to the ink flowing therethrough is very small and, therefore, a sufficient amount of ink for printing can be supplied to the recording head 4.

Further, since the porous member 21 is resiliently deformed and compressed by the ink supply port 15 projecting inward of the tank housing, the pore size of the porous member at a region in the vicinity of the ink supply port is smaller than that of the other region so that the capillary force is large relative to the other region. Owing to this structure, the ink is concentrated at the compressed portion of the porous member, and further the ink can be supplied to the recording head right up until the last droplet.

In the above embodiment, the sealing member 20 disposed at the ink supply port 15 is exposed. However, it is more preferable to form a flange 45 surrounding the sealing member 20 for avoiding unintentional touch by a finger F to the sealing member 20 as shown in Fig. 8. This arrangement of the flange 45 is advantageous in that not merely the sealing member is prevented from being torn but also the flange can be used as a guide member for easily positioning the ink supply needle 14 to the correct point.

Figs. 9-I and 9-II are cross-sections showing an ink tank cartridge according to a second embodiment of the present invention. The ink tank cartridge of the second embodiment is provided with a housing 50 constituting an ink tank cartridge body having an opening 51 at the top thereof and a pipe-like ink supply port 53 projecting from a bottom surface 52 of the housing 50, which port engages with the ink supply needle 14 disposed on the recording apparatus side. The housing 50 is tapered so that a diameter of the bottom surface is smaller than that of the top surface. The ink supply port 53 is provided with an opening 54 onto which a filter 55 formed of high polymer or anti-corrosion metal is fuse bonded. A step portion 56 is formed at an inner center of the ink supply port 53. A packing member (an O-ring in this embodiment) 57 is fitted at a lower side of the step portion 56 for maintaining a liquid seal by resiliently abutting the port 53 against the ink supply needle 14. Further, a sealing member (film) stopping member (an O-ring in this embodiment) 58 is also fitted at a lower side of the packing member 57. An opening 59 is sealed by a sealing member 60 having a high air-seal formed, for example, of a laminated film through which the ink supply needle easily penetrates. The opening 51 of the housing 50 is sealed by a lid 62 having a communication hole 62 for communicating with the atmosphere. An inner surface of the lid 62 is provided with a plurality of ribs 68 for defining spaces 63 between a porous member 64 and the lid 62. The ink tank cartridge is further provided with electrodes 65a, 65b for detecting an ink near-end condition.

In Fig. 9-I the porous member accommodated in the tank housing 50 has two separate layers consisting of upper porous member 64a and lower porous members 64b. The upper porous member 64a is larger in pore size than the lower porous member 64b so that the capillary force is larger at the lower side in the vicinity of the ink supply port 53. The elements of the structure of the cartridge of this arrangement other than the porous member is the same as that shown in Fig. 9-I.

Although this arrangement has the two-layer structure of the porous member, the porous member may be divided into more than two layers if applicable as well as the lower layer having a small pore size than the upper layer.

With the ink tank cartridge described above, deaerated ink is filled within the porous member accommodated in the tank housing under low pressure, and packed in a package bag for stocking while maintaining a negative pressure a little bit higher (closer to the atmosphere) than that during the ink-filling process. When the ink tank cartridge is exchanged with a new one, the packaging bag is opened to take a new ink tank cartridge out of the bag, and the tank cartridge is mounted on the carriage of the recording apparatus in such a manner that the end opening of the ink supply port 53 is positioned just above the ink supply needle 14 and then depressed towards and parallel to the direction of the needle 14.

In this operation, the ink supply needle 14 pen trates the sealing member (film) 60 and reaches the packing member (O-ring) 57 through the sealing member stopping member 58. This enables the ink supply needle 14 to be kept in a liquid-tight condition with respect to the ink supply port 53 by the packing member (O-ring) 57 while communicating with ink contained within the ink supply port 53.

When the ink supply needle 14 penetrates the sealing member 60, the sealing member 60 may partially go into the ink supply port 53 with the ink supply needle 14. However, broken pieces 60a of the sealing member 60 is stopped to go further with the needle by the sealing member stopping member 58 as shown in Fig. 10B so that the brok n piec s 60a do not reach the packing member 57. Accordingly, even if gaps 66 are formed between the needle 14 and the sealing member stopping member 58, the liquid seal can be maintained owing to the packing member 57 and, therefore, the ink is prevented from leaking out. Various modifications of the packing member 57 and the sealing member stopping member 58 are now described. The remaining elements of the structure, however, remain the same.

In Fig. 10A-2 the sealing member stopping member 58-2 is not an O-ring but an elastic sealing member while the sealing member 57 is an O ring.

In Fig. 10A-3 both the sealing member 58 and the sealing member stopping member 58 are not an O-ring but an elastic sealing member.

In Fig. 10A-4 the sealing member 57 and the sealing member stopping member 58 are unitarily formed and provided with a groove between the members.

In Fig. 10A-5 the sealing member 57 is not an O-ring but an elastic sealing member while the sealing member stopping member 58 is an O-ring.

Fig. 11 is a cross-section showing part of an ink tank cartridge according to a third embodiment of the present invention. As shown in Fig. 11, a pipe-like ink supply port 71 is formed at the bottom surface 70 of the housing for accommodating a porous member for filling therein ink. A filter 72 is fixed to a top opening of the ink supply port 71 which resiliently abuts to compress the porous member for impregnating ink. A packing member 73 and a seal member stopping member 74 are press fitted in a center inner portion of the ink supply port 71 and secured by a bushing 75. A lower opening 76 is sealed by a sealing member (film) 77.

The ink tank cartridge of this embodiment is further provided with a porous member 81 fitted in the ink supply port 71 between an electrode 80 disposed within an ink chamber 79 for detecting an ink near-end condition and the packing member 73. An upper portion of the porous member 78 engages with a step portion 81 formed inside the ink supply port 71 as shown in Fig. 11 to prevent the porous member 81 from moving even when the ink supply needle penetrates therethrough. The reference numeral 95 designates another electrode for detecting the ink near-end condition.

Fig. 12 shows an embodiment of the ink supply needle 90 preferably applied to the ink tank cartridge of the present invention. The ink supply needle 90 is provided with a tip 91 having a conical shape and an inclined surface for easily penetrating the sealing member 77, stopping member 77 and packing member 73. A needle body 92 has generally parallel openings 94 communicating with an ink supply path 93.

In this embodiment, when the sealing member 77 is positioned onto the ink supply needle 90 and mounted, the ink supply needle 90 penetrates the sealing member 77 and passes through the sealing member stopping member 74 and the packing member 73. Since the ink supply needle 90 has no hole at the tip 91, the variation in volume in the ink chamber 79 caused by a piston-effect during the mounting operation of the ink tank cartridge, is received by the tip 91 and the packing member 73. Whereas the variation is not applied to the through hole 93 as shown in Fig. 13A but to the upper side through the porous member 78 of the ink supply port 79. Thus, when the openings 94 pass through the packing member 73 pressure is generated when the cartridge is being mounted and so ink flows into the ink supply path 93 through the openings 94.

As described above, during the mounting operation of the ink tank cartridge, the undesirable variation in volume due to the piston effect applied to the recording head can be prevented since the ink supply path 93 does not communicate with the ink supply port 71, so that leakage of ink from the nozzle opening of the recording head is effectively avoided. Further, since it is not necessary to form through holes, the ink supply needle has sufficient mechanical strength and, accordingly, the needle can be formed of a material other than metal such as, for example, a high polymer material. An ink supply needle formed of high polymer material is advantageous in that the manufacturing process can be simplified and further dangers raised because of metal can be avoided.

Furthermore, an inner diameter of the through holes 94 can be selected freely yet maintain the meniscus even if an outer diameter of the ink supply needle is designed to b large to thereby control an appropriate flow resistance. Ther fore, the ink supply needle can maintain a mechanical strength sufficient for penetrating into the ink tank cartridge if the needle is formed of a high polymer material.

Preferably, the ink supply needle shown in Fig. 13B is so d signed that, for example, an outer diameter R of the needle is within a range of 2-4mm and a length L of the ink supply port of the ink tank cartridge side when the ink tank cartridge is mount d onto the needle and the packing member is set to be below 2.5mm. This arrangement is more preferable because the variation in volume when the ink tank cartridge is

mounted on the ink supply needle is small and the undesirable piston effect can be minimized.

On the other hand, if the ink tank cartridge must be replaced when the tank is still full such as for maintenance, ink existing around the tip of the ink supply needle is sucked up into the porous member 78 located in the vicinity of the needle because of capillary action of the porous member filled within the tank cartridge for impregnating the ink. In this operation, since the porous member 78 has a capillary force which is substantially the same as that of the porous member filled in the tank cartridge, the ink remains in the ink chamber 79. Accordingly, air is prevented from entering inside the tank cartridge body. Further, if the ink tank cartridge is removed, the electrodes do not output a signal representing the ink near-end condition. As a result, it is ready to start printing again merely by mounting the once removed ink tank cartridge again onto the ink supply needle.

The third embodiment describes the needle having parallel through holes. However, the needle having through holes in the end surface as shown in Fig. 3 may be employed if the piston effect during mounting of the cartridge is small.

Further, the ink tank cartridge of the third embodiment utilizes stopping members for preventing the packing member and the sealing member stopping member from falling off. However, these stopping members may be omitted if the mechanical strength of the sealing member is relatively large.

As described above, according to the present invention, the ink tank cartridge housing is removable with respect to the ink supply needle and is provided with the ink supply port projecting from the bottom surface of the housing both inwardly and outwardly. The porous member for impregnating ink is resiliently accommodated in the housing through the filter secured to the end of the ink supply port. The packing member is disposed at the end opening of the ink supply port for resiliently abutting against the periphery of the ink supply needle and the sealing member for sealing the end opening of the ink supply port, through which the ink supply needle penetrates. Accordingly, the ink tank cartridge of the invention is advantageous in that the ink supply needle does not require a sharp tip, air is prevented from entering the ink supply path of the recording apparatus, and a tight air-seal between the ink supply needle and the ink tank can be maintained.

Embodiments of the present invention have been described and it will be appreciated by a person skilled in the art that modifications may be made without departing from the scope of the present invention as defined in the appended claims.

Claims

1. An ink tank cartridge for an ink-jet type recording apparatus, the cartridge being removably mounted onto an ink supply needle (14,90) having through holes (36,94) and mounted on the recording apparatus body, the cartridge comprising:

   a housing (11,50);

   an ink supply port (15,53,71) projecting from a bottom surface of said housing inwardly; characterised by

   a porous member (21,64) accommodated in said housing for impregnating an ink, said porous member resiliently abutting against said ink supply port through a filter (17,55);

   packing means (19,57,73) for resiliently abutting against an outer periphery of said ink supply needle of the recording apparatus; and

   means (20,60,77) for sealing an end opening of said ink supply port, said ink supply needle penetrating through said sealing means.

2. An ink tank cartridge as claimed in Claim 1, wherein said packing means comprises a resilient ring.

3. An ink tank cartridge as claimed in Claim 1 or 2, wherein said porous member is compressed at a region in the vicinity of said ink supply port.

4. An ink tank cartridge as claimed in any one of claims 1 to 3, further comprising

   means (58) provided between said packing means and said sealing member for preventing broken pieces of said sealing member produced when said ink supply needle penetrates said sealing member.

5. An ink tank cartridge as claimed in any one of the preceding claims, in which said ink supply port projects both inwardly and outwardly from said bottom surface.

6. An ink tank cartridge as claimed in any one of the preceding claims, further comprising a resilient porous member (81) disposed within said ink supply port at a region where the through holes of said ink supply needle are located and an ink chamber (79) defined between said resilient porous member and said filter of said ink supply port.

7. An ink tank cartridge of Claim 6, wherein said resilient porous member has a capillary force which is substantially the same as that of said porous member accommodated within said housing for impregnating the ink.

8. An ink-jet recording apparatus as claimed in any one of claims 1 to 7 wherein said plurality of through holes are formed on said needle perpendicularly to a direction in which said needle penetrates.

9. An ink-jet recording apparatus as claimed in any one of claims 1 to 8, wherein an outer diameter R of said ink supply needle is within a range of 2-4mm and a length L of said ink supply port of said ink tank cartridge side when said ink tank cartridge is mounted onto said needle and said packing member is set to be below 2.5mm.

10. An ink tank cartridge as claimed in any one of claims 1 to 7 wherein said ink supply needle comprises a plurality of through holes at a side surface thereof through which the ink passes.

11. An ink tank cartridge as claimed in any one of the preceding claims wherein said filter is fuse bonded onto an upper opening of said ink supply port.

12. An ink tank cartridge as claimed in any one of the preceding claims wherein said filter comprises a mesh filter.

13. An ink tank cartridge of Claim 12, wherein said mesh filter has a pore size of 20 to 100 μm.

14. An ink tank cartridge as claimed in any one of the preceding claims wherein said sealing means is formed of a high polymer film.

15. An ink tank cartridge as claimed in any one of claims 1 to 14, wherein said sealing means is formed of a high polymer film with metal layer laminated on said film.

16. An ink tank cartridge as claimed in any one of the preceding claims wherein said sealing means is surrounded by a wall projecting from a lower end of said ink supply port.

17. An ink tank cartridge as claimed in claim 6, wherein said ink supply port comprises a step portion formed inside thereof with which said resilient porous member engages.

18. A container for an ink tank cartridge as claimed in any one of claims 1 to 17, wherein said ink tank cartridge is packed in an air-sealable container under a low pressure so that a space is maintained in said container.

19. A container as claimed in claim 18, wherein said space is at least 15% of the total inside volume of said container.

20. A container as claimed in claim 18 or 19 wherein said space is maintained by a space disposed at upper side of the container.

21. A container as claimed in any one of claims 18 to 20, wherein said space is maintained by absorbing members packed with said cartridge.

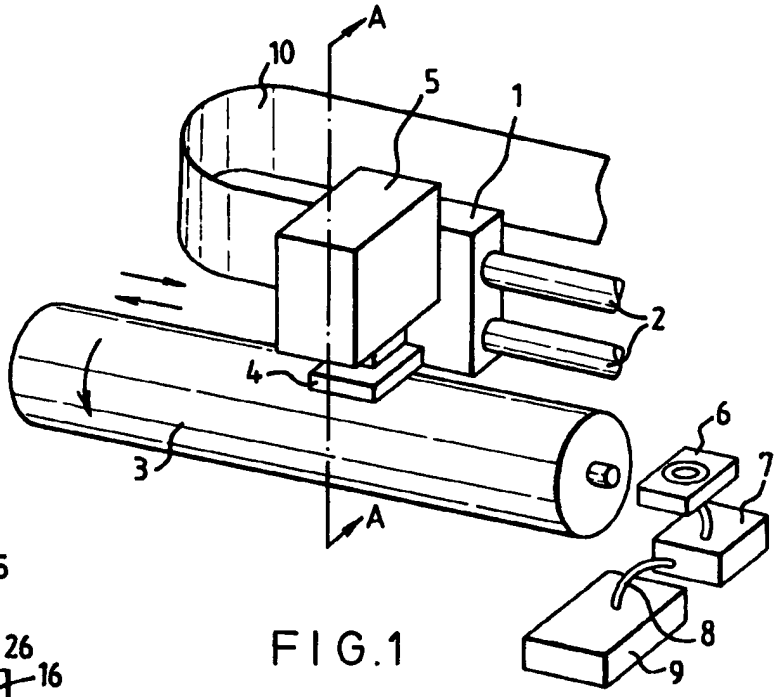

FIG.1

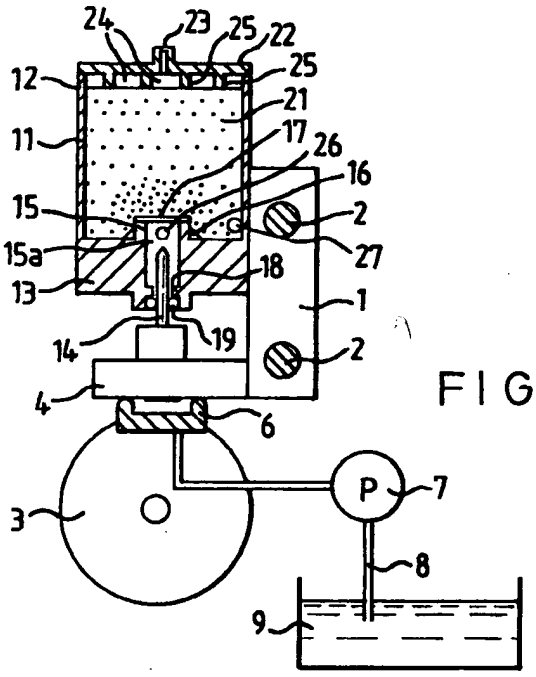

FIG.2

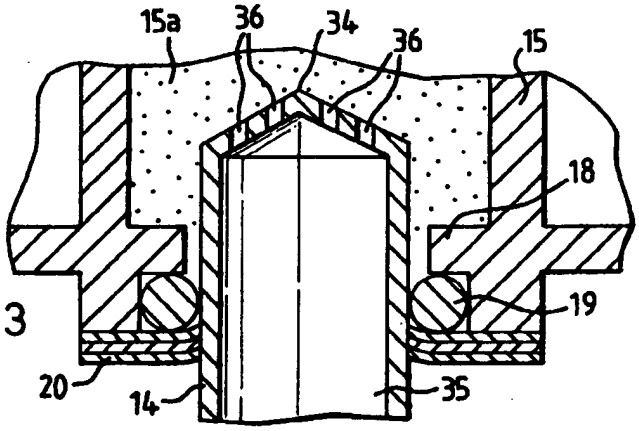

FIG.3

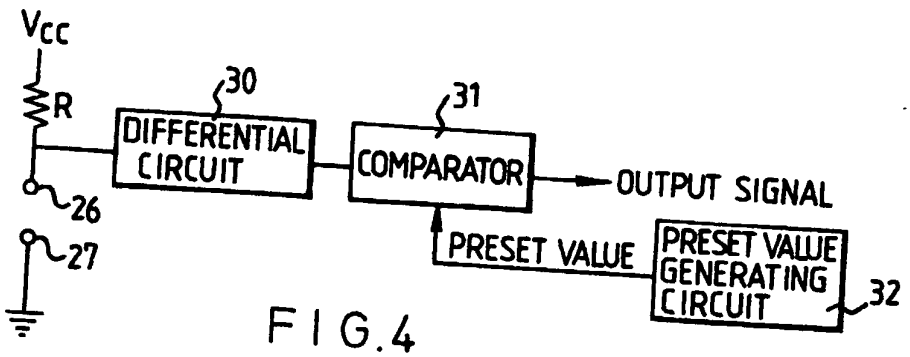

FIG.4

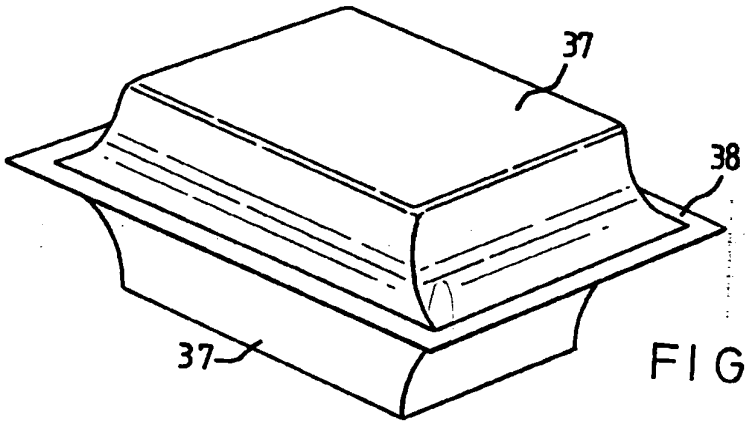

FIG.5

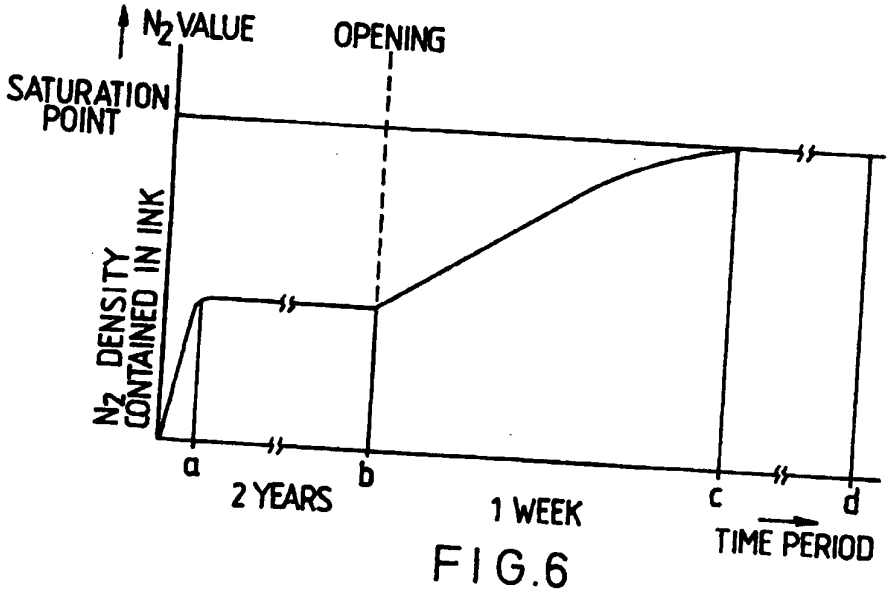

FIG.6

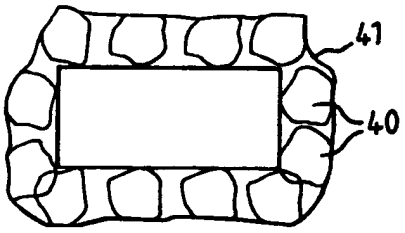

FIG.7

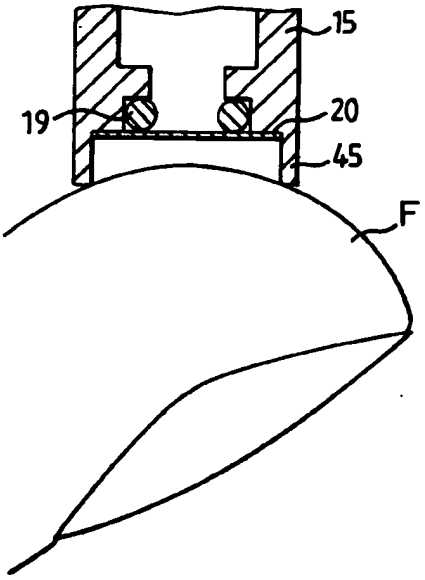

FIG.8

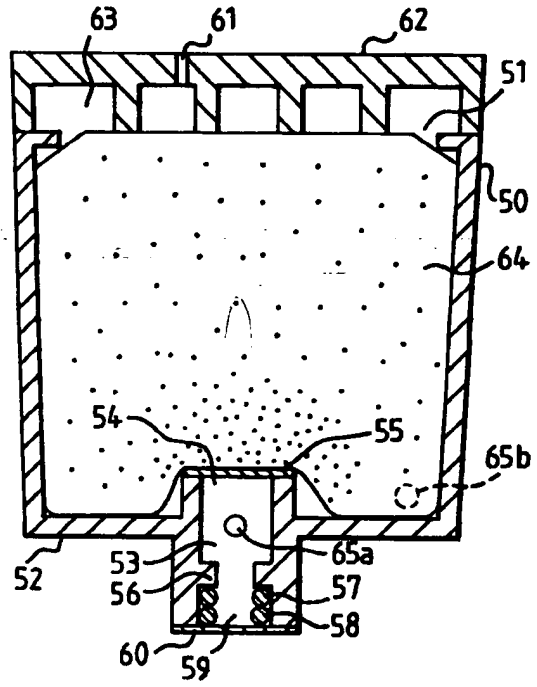

FIG.9-I

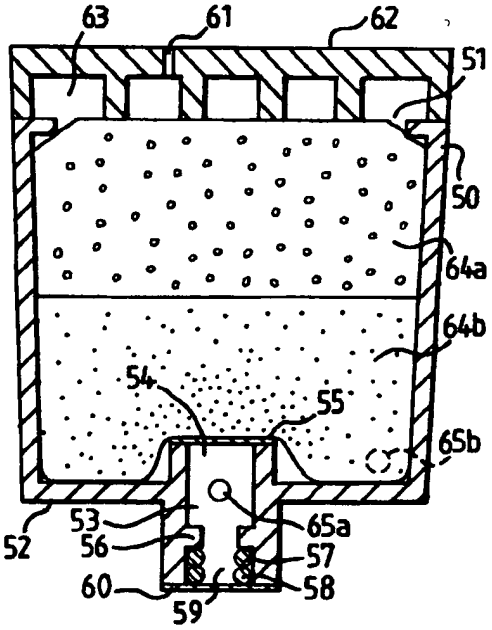

FIG.9-II

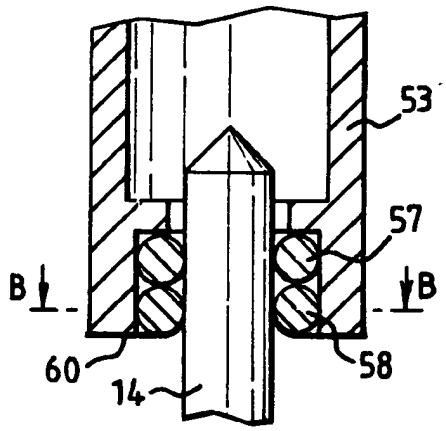

FIG.10A-1

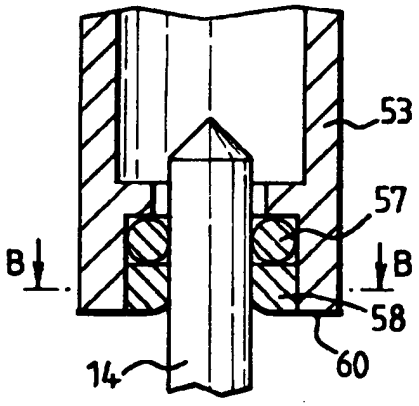

FIG.10A-2

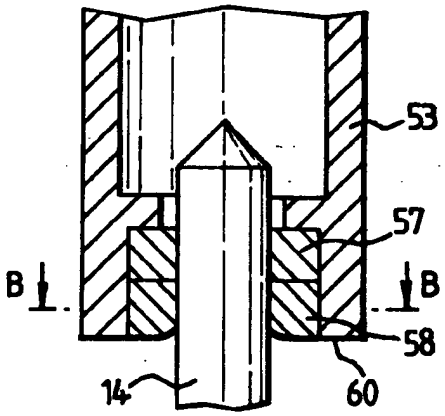

FIG.10A-3

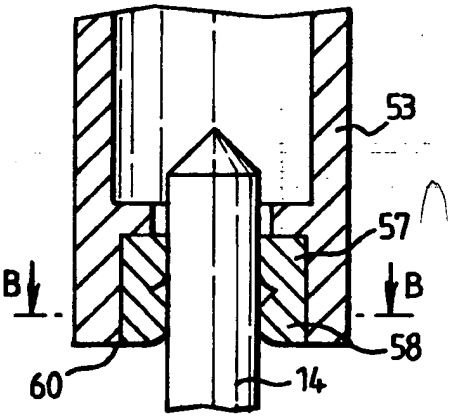

FIG.10A-4

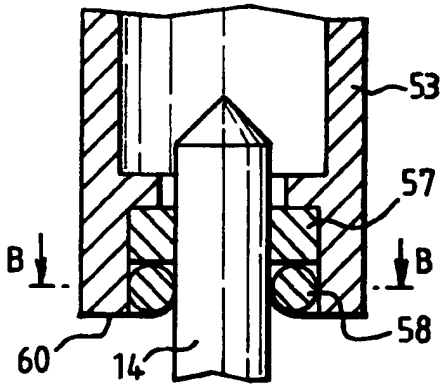

FIG.10A-5

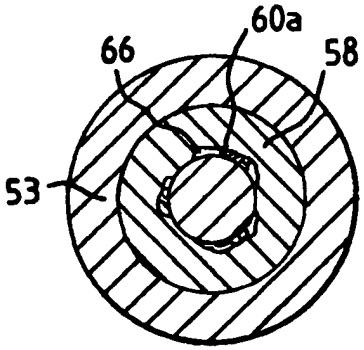

FIG.10B

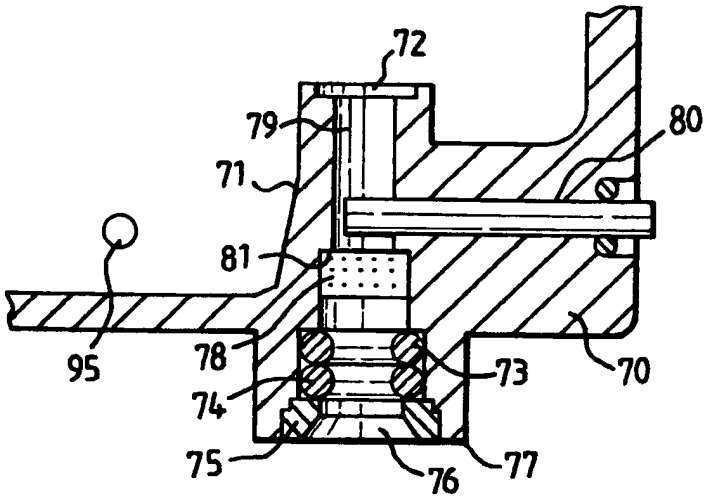

FIG.11

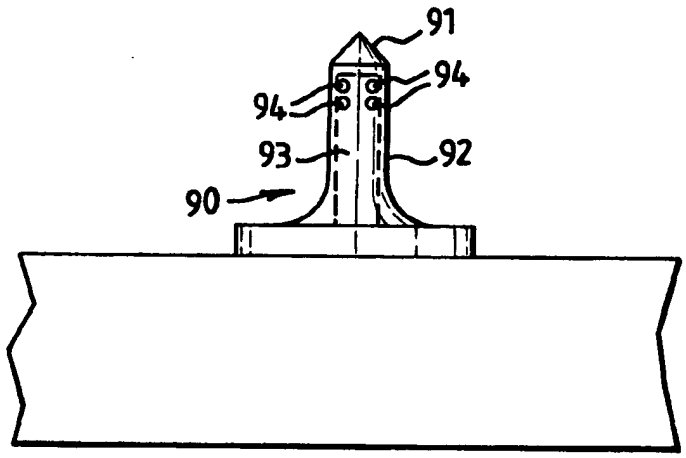

FIG.12

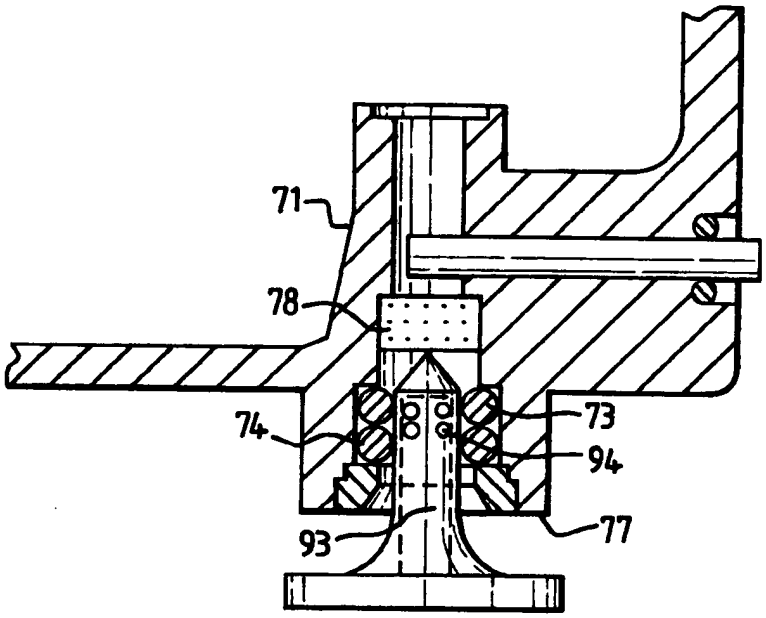

FIG.13A

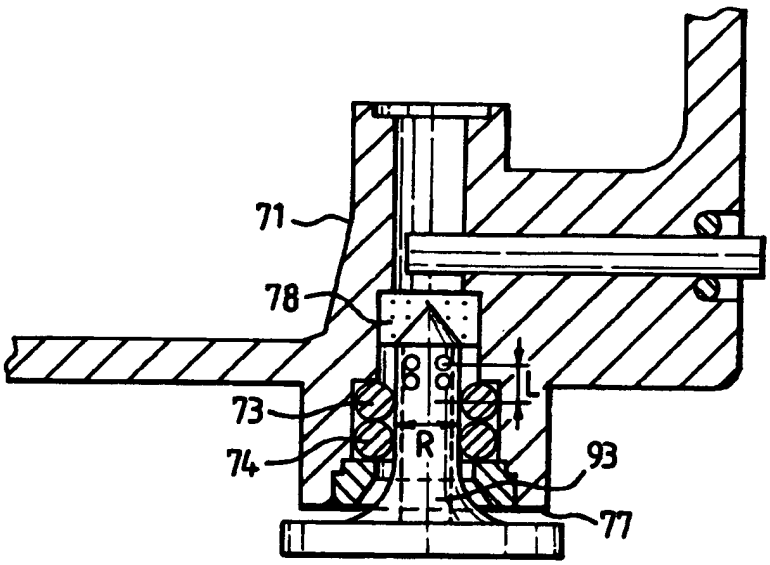

FIG.13B

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 30 7270

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 408 241 (OLIVETTI) * column 2, line 9 - column 6, line 33; figures 1-3 *	1	B41J2/175
A	GB-A-2 003 793 (BELL&HOWELL COMPANY) * abstract; figures 1,2,7 *	2	
A	EP-A-0 117 718 (SHARP) * abstract; figure 3 *	10	
A	PATENT ABSTRACTS OF JAPAN vol. 12, no. 416 (M-759)(3263) 4 November 1988 & JP-A-63 154 356 (RICOH CO LTD) 27 June 1988 * abstract *	10	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04 JUNE 1993	DE GROOT R.K.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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